SPIXIANA	21	3	253–270	München, 01. November 1998	ISSN 0341-8391

Three species of *Tanytarsus* involved in California midge nuisance problems: descriptions, ecology, and faunal relations

(Insecta, Diptera, Chironomidae)

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Spies, M. (1998): Three species of *Tanytarsus* involved in California midge nuisance problems: descriptions, ecology, and faunal relations (Insecta, Diptera, Chironomidae). – Spixiana **21/3:** 253-270

Tanytarsus challeti, spec. nov. and *T. pelsuei*, spec. nov. are described and diagnosed in the larval, pupal and adult stages. *T. angulatus* Kawai is first reported from the Nearctic region. Its adult male description is emended, the previously unknown adult female, pupa, and larva are described, and diagnoses for all stages are provided. The species' ecologies, nuisance potentials, distributions and systematic relations are discussed. While the closest relatives of *T. challeti*, spec. nov. and *T. pelsuei*, spec. nov. are found in Australia, *T. angulatus* Kawai appears to have originated in the eastern Palaearctic. *Tanytarsus takahashii* Kawai & Sasa is newly recorded from China and North Korea.

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Introduction

Every spring and summer, government agencies in southern California receive numerous complaints from residents and businesses about non-biting "nuisance" midges from local inland water bodies. In the summer of 1992 two agencies in charge of controlling these problems, the Orange County and Greater Los Angeles County Vector Control Districts, initiated a project to identify the Chironomidae involved in the phenomenon. During this study several species of the genus *Tanytarsus* were encountered, three of which are described below. The general results of the nuisance midge project and descriptions of other taxa are to be presented in several further publications currently in press or in preparation by the present author (and collaborators).

Methodology

Specimens were collected with a variety of samplers: an Ekman grab for deeper-lying sediments, an aluminum scoop (described in Anderson et al. 1964) for scraping substrate surfaces in shallow water, Brundin-style drift nets, aerial nets and aspirators. Final instar larvae and pupae were individually reared in the laboratory to obtain reliable life stage associations.

Wherever possible, standard morphological terminology is followed (combined from Sæther 1980, Cranston & Reiss 1983, Coffman 1986, Pinder & Reiss 1986, and Oliver & Dillon 1989). Pupal lamellar setae (= "filamentous" setae, Schlauchborsten) are called "taeniae" after Langton & Armitage (1995).

Two new terms are introduced: 1. "Sensillar pit" denotes a depression ("grubenartige Vertiefung" of Reiss & Fittkau 1971) on the adult male anal point, clearly outlined in dorsal aspect, and usually containing sensillae basiconicae; 2. "Setiger" is used for the distal, setae-bearing part of the adult male superior volsella, distinguishable from the volsellar stem by an abrupt expansion to dorsal and usually also to median.

For each life stage, a table is given allowing direct comparisons of diagnostic characters. The text descriptions give features not listed in the tables, but also repeat those warranting special mention. Meristic data are generally presented in the format: value range (No. of values). If the value distribution is significantly skewed, n is preceded by the median value: x-y (M; n).

Abbreviations of life stages: ex = exuviae, L = larva, P = pupa, ph = pharate adult.

Abbreviations of names and institutions: GLACVCD = Greater Los Angeles County Vector Control District (Santa Fe Springs, California); JES = Prof. James E. Sublette (Tucson, Arizona); OCVCD = Orange County Vector Control District (Garden Grove, California); UCR = University of California at Riverside, Dept. of Entomology; ZSM = Zoologische Staatssammlung München (Munich, Germany).

Tanytarsus challeti, spec. nov.

"*Tanytarsus (Tanytarsus)* n. sp. 57" Whitsel et al., 1963; records and biology.

Etymology. Named after Gilbert L. Challet (last name pronounced as if French), former manager of the Orange County Vector Control District, for initiating and supporting basic taxonomic work, and staying committed in times of economic adversity. When using the species epithet in speaking, the francophone pronunciation should be maintained to keep the name dedication recognizable.

Description

Larva (see tab. 1).

Coloration. Head yellowish to light brown, postoccipital margin darker. Thorax reddish with green reticulation, abdomen pale red, segments II-VII with greenish lateral ridges. In prepupae: red tinges fading, greenish areas increasing.

Head. Labrum with SI combed, SII simple and bladelike, SIII, SIV simple, fine; chaeta media combed, several neighboring chaetae apically feathered. Premandible with 4 darkened teeth (the most proximal small), and with the usual lateral spine. Mandible with 1 dorsal (pale), 1 apical and 3 inner teeth (dark). Antenna (Fig. 4A) with seta at about ⅔ length of segment I; blade shorter than segment II; Lauterborn organs not reaching tip of segment III. Mentum with trifid median and 5 pairs of darker lateral teeth.

Tab. 1. Larval character data for three species of *Tanytarsus*.

Larval (4th instar) character	*challeti* spec. nov.	*pelsuei* spec. nov.	*angulatus* Kawai
Total length [mm]	5-6	4.5-5.5	4-6
Postmentum length [µm]	155-180 (12)	135-155 (6)	150-170 (11)
Postmentum pigmentation	absent	transverse band	median field
Clypeal seta (S3)	simple	simple	simple
Labral seta SI	combed	branched	combed
Labral seta SII	simple	simple	simple
Labral chaetae	some branching	all simple	all simple
Premandibular teeth	dark	dark	light
Antennal pedestal	without spur	without spur	without spur
Antennal ratio	1.4-1.7 (9)	2.0-2.5 (2.4; 4)	1.9-2.3 (2.2; 11)
Antennal seg. I/II (sclerot. sections only)	3.4-4.5 (11)	5.0-5.3 (5)	4.7-6.2 (10)
Antennal seg. III/IV (sclerot. sections only)	1.5-2.1 (2.1; 9)	1.3-1.6 (4)	1.3-1.8 (7)
Lauterborn pedicel + organ/ant. seg. III-V	at most 0.5	about 1.5	1.5-2
Supraanal seta length [µm]	135-235 (200; 11)	70-80 (3)	80-110 (5)
Anal tubules	short, wide	elongate	elongate

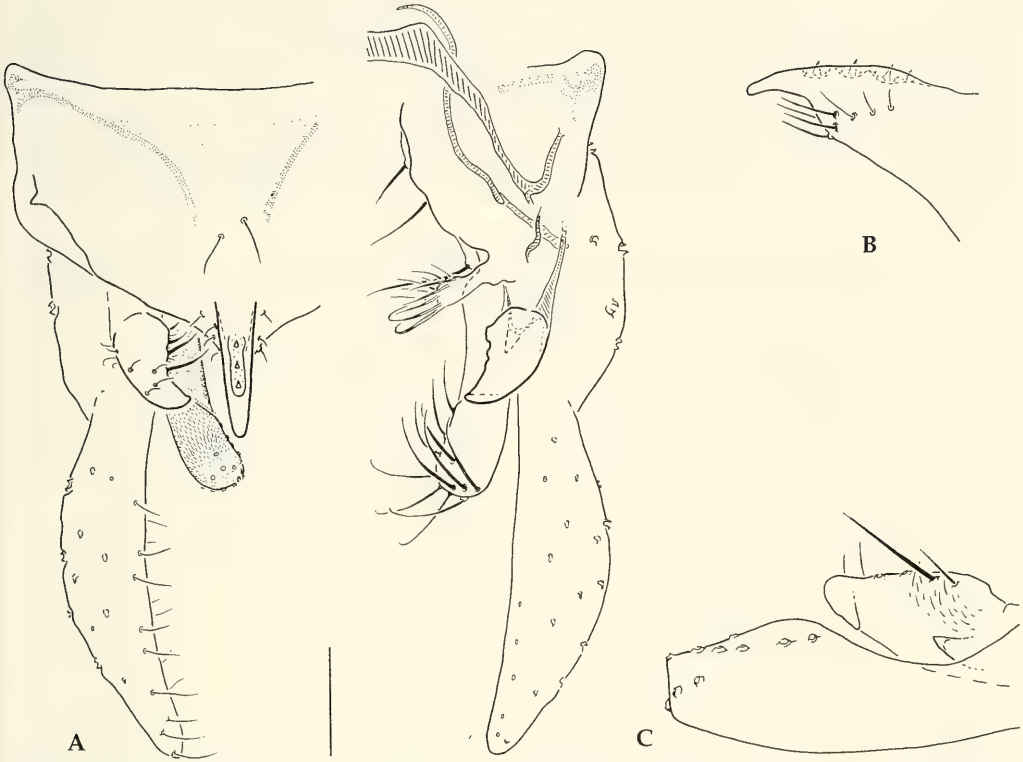

Fig. 1. *Tanytarsus challeti*, spec. nov. Adult male. **A.** Hypopygium, dorsal (scale 50 µm). **B.** Anal point, lateral. **C.** Superior and inferior volsellae, median aspect.

Abdomen. Segments II-VII with lateral longitudinal ridges, the ends of the latter on VII at most slightly bulging to posterior. Procercus low, distally sclerotized, with 6-8 anal setae and 2 short lateral setae. Anal tubules no longer than wide, far shorter than supraanal setae.

Tubes of detritus, often 3-4× length of larva or pupa.

Pupa (see tab. 2).

Coloration. Olive green to brownish. Exuviae with cephalothorax mostly brown incl. wing sheath vein traces; abdominal tergite II with pair of longitudinal pigment patches, TVIII laterally, almost all of TIX brownish.

Head. Cephalic tubercle (CT) prominent, its narrowed apex short (Fig. 5A), at most ¼ length of frontal seta. Antennal pedicel sheath with tubercle at least as long as apex of CT.

Thorax. Median suture anteriorly flanked by at least narrow strips of granules often including some with sharper peaks. Precorneal setae in a row, or a shallow to steep triangle, slanting from anterodorsal to posteroventral. Thoracic horn (Fig. 5B) with sparse chaetae about 3 horn diameters in length lining approximately 2nd and 3rd ⅙ of horn length; chaetae difficult to see if slide-mounted adpressed to horn, occasionally absent. One dorsocentral seta of each unilateral pair often slightly longer and weaker. Prealar mound an elongate, low ridge.

Abdomen. Tergite armament: TII with shagreen reduced to four remnant fields at ends of usual "Π" pattern; hook row spanning about ⅓ of segment width (½ of T); TIII-VI with pairs of longitudinal bands of points set on brown pigment (similar to fig. 5D, but without antero-lateral TIII shagreen), bands limited to anterior halves of tergites, usually longest on IV, shortest on VI, slightly narrower on III; TVIII, IX with small anterolateral shagreen patches. Sternite armament: SI, II with extensive fine shagreen, SVIII with antero-lateral shagreen. Dorsal setae I-II: 2; III-VII: 5; VIII: 1 (postero-lateral);

O-setae: 1 pair each on II-VII; sensillae campaniformes absent. Lateral setae I: 0; II-V: 3; VI: 2 regular setae + 1 posterior taenia (rarely reduced to long, non-taeniate); VII: 2-3 regular + 1-2 taeniae; VIII: normally 5 (occasionally only 4) taeniae with $L_{2,3}$ displaced toward median, 1-2 setae may be reduced to regular. Ventral setae I: 0; II: 3; III-VII: 4; VIII: 1 central pair, non-taeniate. PsA absent. PsB weak, rarely prominent. Anal comb with 4-9 marginal teeth, ventral surface ("disc") relatively small, with 2-7 sometimes minute spines. Anal lobe fringe often with the most anterior setae much shorter, semi-spinose.

Adult male (see tab. 3).

Coloration. Thorax mostly brown, vittae slightly darker but little contrasting, scutellum and weakly sclerotized areas greenish; abdomen with terga brown, otherwise greenish. Wing squama with a dark spot.

Head. Eye extension reaching little more to median than ventral end of eye, with median marginal contour indistinct, grading into microtrichiose frons. Frontal tubercles digitiform.

Thorax. Antepronotum only on 1 specimen with 1 lateral seta. Scutellum usually with three discrete groups of setae, the median group set slightly more posterior.

Wing. Membrane setae almost always limited to distal portions of cells r_{4+5} and m_{1+2}; cells m_{3+4} and cu_1 with 2-3 setae in only 1 and 2 of 12 specimens, respectively. Anal lobe not prominent.

Legs. Segment lengths as percentage proportions of the respective tibia (n=4):

	fe	ti	ta_1	ta_2	ta_3	ta_4	ta_5
P_1	132-138	100	166-179	75-82	67-74	52-56	24-27
P_2	111-120	100	51- 60	30-34	26-30	18-21	13-14
P_3	95-100	100	64- 67	39-40	35-36	22-24	12-14

Tibial spur length increasing from P_1 to P_3, on P_2 and P_3 one spur slightly longer than the other; mid and hind tibial combs separate, fully developed.

Hypopygium (Fig. 1). Anal tergite bands separate, usually ending far anterior of anal point origins. T IX with 0-3 (13 of 17 specimens: 2) dorsomedian and 8-15 distal setae; lateral tooth very variable: absent, simple, apically bifid, or double, up to 20 µm long. Anal point with more or less narrowed, rounded apex; sensillar pit always present but of limited extent, with 1-4 (M=3; 16 of 18 with at least 2) sensillae basiconicae surrounded by sparse microtrichia in more extensive pits; no anal point crests

Tab. 2. Pupal character data for three species of *Tanytarsus*.

Pupal character	*challeti* spec. nov.	*pelsuei* spec. nov.	*angulatus* Kawai
Total length [mm]	4.1-5.2 (10)	3.4-4.6 (4)	3.0-4.8 (12)
Frontal seta length [µm]	90-120 (6)	90-100 (2)	80-150 (125; 7)
Cephalic tubercle, apex length [µm]	15-35 (6)	45-70 (4)	25-50 (6)
Pedicel sheath tubercle length [µm]	35-40 (4)	10-20 (4)	max. 15 (8)
Thoracic horn length [µm]	350-600 (5)	330-375 (4)	225-450 (10)
Thoracic horn surface	with 0-12 chaetae	with 0-9 chaetae	bare
Median antepronotal setae	1	1	1
Lateral antepronotal setae	1 seta, 1 sensilla	1 seta, 1 sensilla	1 seta, 1 sensilla
Precorneal setae, arrangement	variable	in slanted row	in slanted row
Precorneal setae, size	(Pc_2+) Pc_3 smaller	$Pc_1 > Pc_2 > Pc_3$	Pc_1 stronger
Dorsocentral setae	subequal to inequal	$Dc_4 > Dc_3 > Dc_{1,2}$	Dc_3 weaker
Wing sheath nose	absent, rarely very low	present, rarely low	often low, rarely absent
Abdom. seg. VIII ventral seta	not enlarged	strong to taeniate	taeniate
Abdom. seg. VIII dorsal seta	1, not enlarged	2; 1 strong	1, strong
Abdom. seg. V-VIII lateral taeniae	0/(0)1/(1)2/(3-)5	0/0-1/2/5	(0)1/(0)1/(1)2/5
Anal lobe taeniae, dorsal	2	2	2
Anal lobe taeniae, fringe	30-45 (9)	35-40 (4)	43-54 (13)

evident (compare figs 1B and 3B). Superior volsella (Figs 1A, C) with setiger in lateral view strongly, in dorsal aspect at most moderately narrowing, apex with a ventromedian lip or hook; setiger bearing extensive medio-proximal field of microtrichia varying in length, 2-5 median setae (usually 3, the distal 2 stronger), and 7-10 small dorsal to lateral setae; digitus a conical stub not visible from dorsal, 12-24 % of setiger length. Inferior volsella densely microtrichiose, distally with ridge-like expansion to dorsal (Fig. 1C), and median to caudal setae. Median volsella with stem shorter than setiger of superior volsella, distally setose, with 2-3 lamellate setae of spatulate type (Sæther 1980: fig. 23). Gonostylus moderately widened in midsection, apex rather blunt.

Adult female.

Similar to male except as listed in tab. 4. Genitalia: indistinguishable from other *Tanytarsus* females studied.

Systematics. In the preliminary scheme of Holarctic *Tanytarsus* species groups based on pupal and male adult morphologies (Pinder & Reiss 1986, Cranston et al. 1989), *T. challeti*, spec. nov. and the highly similar *pelsuei*, spec. nov. best fit with the *mendax* group. However, after global-level comparisons of published descriptions and specimens held at ZSM, the new species are considered most

Tab. 3. Adult male character data for three species of *Tanytarsus*.

Adult male character	*challeti* spec. nov.	*pelsuei* spec. nov.	*angulatus* Kawai (USA)	*angulatus* Kawai (Japan) [A, B]
Wing length [mm]	1.85-2.50 (17)	1.72-2.16 (12)	1.72-2.40 (8)	1.48-1.98
Temporal setae	13-22 in 1-2 rows	10-16 in 1-2 rows	11-15 in 1 row	10-13
Frontal tubercles [LxW in µm]	19-31 x 7-8	22-43 x 7-15	38-56 x 8-14	A: 60 x 15
Antennal ratio (13 flagellomeres)	0.99-1.16 (17)	1.18-1.45 (13)	1.13-1.39 (10)	1.10-1.36
Clypeus setae	23-45 (11)	18-29 (11)	17-27 (9)	10-21
Palpomere lengths 2-5 [µm]	30-40	35-40	35-50	A: 33, 35
	85-105	105-120	125-155	A: 108, 135
	95-110	120-140	125-155	A: 110, 135
	140-180	195-225	210-235	A: 234, 235
Scutal tubercle	absent	absent	absent	–
Antepronotal setae	0-1	0	0	0
Acrostichal setae	9-19 (15)	10-17 (12)	13-19 (10)	9-15
Dorsocentral setae	7-14 (26)	8-13 (16)	7-13 (10)	8-12
Prealar setae	1-3 (1; 17)	1-2 (13)	1 (9)	1-2
Supraalar setae	0	0	0	0
Scutellar setae	4-9 (6; 16)	6-9 (7; 13)	6-9 (6; 9)	6-8
Wing VR	1.05-1.08 (3)	1.08-1.16 (5)	1.12-1.15 (3)	A: 1.09-1.15
Wing vein setae: R	19-23 (6)	19, 20	28-33 (3)	A: 25, 31
R_1	4-17 (6)	13, 19	24-28 (3)	A: 21, 23
R_{4+5} , dorsal	11-21 (6)	18, 22	26-34 (3)	A: 33 (2)
R_{4+5} , ventral	3-8 (6)	3 (2)	9-12 (3)	–
M	0 (6)	0 (2)	0 (3)	A: 0 (2)
M_{1+2}	11-20 (5)	33, 47	57-58 (3)	A: 42 (2)
M_{3+4}	0-3 (2)	19, 22	30-35 (3)	A: 21, 28
Cu_1	0 (6)	17, 18	17-22 (3)	A: 16, 18
An	0 (6)	23, 25	26-31 (3)	A: 31, 33
Beard BR (setae on ta_{1-3})	5-8.5	≥6	4-5	2.5-4.3
Leg ratio LR_1	1.66-1.80 (18)	2.02-2.33 (10)	2.04-2.29 (4)	2.28-2.64
LR_2	0.51-0.60 (5)	0.59-0.63 (4)	0.58-0.62 (6)	0.53-0.64
LR_3	0.64-0.67 (6)	0.65-0.67 (4)	0.62-0.66 (6)	0.65-0.71
Mid ta_1 sensillae chaeticae	3-10 (18)	4-9 (11)	4-7 (7)	A: 3-4
Pulvilli	present	present	present	present

A Entries beginning with "A:" are author's own observations on holotype and three paratypes.
B Unmarked data are quoted from Kawai (1991).

closely related to the Australian *T. semibarbitarsus* Glover and *barbitarsis* Freeman, of the *fuscithorax* group (Glover 1973). The latter are not only similar morphologically, but also ecologically, with the potential for abundant development under both eutrophic and elevated salinity conditions (e.g., Kokkinn 1986).

The data available on members of the *mendax* and *fuscithorax* species groups strongly suggest close phylogenetic relations (including possible synonymies), but a full revision is required to evaluate this hypothesis.

Differential diagnoses

The larva of *Tanytarsus challeti*, spec. nov. can be identified by the combination of characters given in tab. 1. *T. barbitarsis* Freeman, while carrying similar short Lauterborn organ stalks and anal tubules, could not be directly compared in the present study, but possibly differs by the mentum having 4 instead of 2 notches in the median tooth, and outermost teeth directed to sublateral (Kokkinn 1986).

Tab. 4. Adult female character data for three species of *Tanytarsus*.

Adult female character	*challeti* spec. nov.	*pelsuei* spec. nov.	*angulatus* Kawai (USA only)
Wing length [mm]	2.18-2.44 (2.20; 6)	1.55, 2.12	1.70, 1.72
Temporal setae	10-22 in 1(-2) rows	8-12 in 1 row	10-12 in 1 row
Frontal tubercles [LxW in µm]	10-25 x 6-8	15-30 x 8-15	20-22 x 8-10
Antennal ratio (4 flagellomeres)	0.70-0.86 (6)	0.57-0.73 (4)	0.64 (2)
Clypeus setae	35-61 (42; 6)	26-30 (4)	21, 24
Palpomere lengths 2-5 [µm]	30-40	35-40	30, 40
	90-95	95-110	110, 125
	100-120	115-125	130 (1)
	150-185	195, 200	?
Acrostichal setae	9-15 (13; 6)	12-20 (4)	13, 14
Dorsocentral setae	9-17 (6)	11-15 (4)	7-11 (2)
Humeral setae	2-4 (6)	2-4 (4)	2-4 (2)
Prealar setae	1-3 (1; 5)	1 (4)	1-2 (2)
Scutellar setae	6-10 (6)	6-10 (4)	8, 9
Wing VR	1.08-1.14 (6)	1.16, 1.06	1.21 (1)
Wing vein setae: R	23-31 (6)	26, 27	25 (1)
R_1	22-31 (6)	28, 31	25 (1)
R_{4+5} , dorsal	35-51 (39; 6)	35, 36	57 (1)
R_{4+5} , ventral	21-32 (5)	59, 55	20 (1)
M	0-8 (0; 6)	10, 8	0 (1)
M_{1+2}	44-59 (55; 6)	70, 65	85 (1)
M_{3+4}	24-35 (32; 6)	38, 41	43 (1)
Cu	4-22 (10; 6)	29, 26	25 (1)
Cu_1	6-11 (6)	22, 23	21 (1)
An	6-25 (6)	34, 25	30 (1)
Leg ratio LR_1	1.58-1.70 (1.59; 5)	2.23, 1.80	2.17, 2.22
LR_2	0.51-0.56 (6)	0.57, 0.56	0.55 (1)
LR_3	0.63-0.68 (0.63; 6)	0.66, 0.62	0.63 (1)
Mid ta_1 sensillae chaeticae	35-43 (9)	40-51 (4)	18, 26
Sternite VIII setae, transverse	38-50 (40; 6)	30-40 (4)	33, 34
SVIII setae, at vaginal bay	1-3 ea. side	1-4 (4)	3-6 (3; 2)
Notum length [µm]	90-135 (6)	85-100 (3)	75, 85
Seminal capsule length [µm]	55-70 (4)	50, 60	75 (1)
Spermathecal duct, course	straight	winding (?)	?
Spermathecal duct, width [µm]	5-6 (5)	4, 5	?
Gonocoxite IX setae	5-10 (6)	4-8 (4; 4)	5-8 (2)
Tergite IX setae	35-50 (6)	20-32 (4)	22, 26
Cercus length [µm]	100-110 (5)	70-90 (3)	70 (1)

Among other pupae with the "*mendax* group" character pattern – elongate cephalic tubercles, thoracic horn with a partial fringe of long chaetae, abdominal tergites with armament patches of points only, penultimate segment with 5 lateral taeniae – *T. challeti*, spec. nov. is most similar to *T. pelsuei*, spec. nov. and *mendax* Kieffer (Langton 1991). The combination of a cephalic tubercle with a narrowed end at most as long as the pedicel sheath tubercle, vestigial wing sheath nose, absence of antero-lateral shagreen on abdominal tergite III, and only one dorsal seta in the postero-lateral corner of TVIII is unique to *challeti*, spec. nov.. Pupae of Australian *fuscithorax* group members (*fuscithorax* Skuse, *semibarbitarsus* Glover) most strikingly differ by much longer cephalic tubercles, and by the abdominal point patches continuing posteriorly as longitudinal shagreen on at least some tergites (Cranston 1996).

Adult males of *T. challeti* can be distinguished from nearly all congeneric species on hypopygial features alone. The combination of the sensillae basiconicae being concentrated in a discrete pit of limited extent on the anal point surface, a superior volsella with an apical, ventro-median lip or hook on the setiger, and a short digitus, is only matched by *T. pelsuei*, spec. nov., the Australian *T. barbitarsis* Freeman and *semibarbitarsus* Glover (Glover 1973), and the Afrotropical to Mediterranean *T. horni* Goetghebuer. *T. challeti*, spec. nov. differs from *barbitarsis* by the lower antennal ratio at comparable body sizes, the tibial combs showing no signs of reduction, the much more extensive wing setation, and a narrower anal point. From *semibarbitarsus* and *pelsuei*, spec. nov., *T. challeti*, spec. nov. can be separated by consistently lower antennal and fore leg ratios at comparable body sizes, the slightly shortened palpomere 5, and the anal point contour originating far posteriorly. In addition, *pelsuei*, spec. nov. has a much more extensively setose wing (see Table 3). *T. semibarbitarsus*, on the other hand, carries conspicuously longer distal setae on the median volsella. *T. horni* has a wider anal point, lateral rather than median microtrichia on the setiger, and apically acute median volsellar setae of foliate, not spatulate type (compare Sæther 1980: figs 22, 23).

Female adults of *T. challeti*, spec. nov. in the California nuisance study could be identified only by the wing setation: while all other species display female wings well haired nearly to the arculus, in *challeti*, spec. nov. cell an is the only one with setae in the proximal wing half. The number of setae on vein Cu_1 also appears significantly lower. Beyond the local level, a positive identification of *challeti* females is not possible without associated specimens of another life stage.

Types. Holotype: 1 individually associated Lex+Pex+adult ♂ (on 1 slide, in Euparal), USA, California, Orange County, Huntington Beach, Talbert Channel at Adams Avenue, 21.IV.1993, leg. M. Spies, deposited at Snow Entomological Museum, University of Kansas, Lawrence, Kansas, USA.

Paratypes (all slide-mounted in Euparal; from USA, California): **A.** Los Angeles Co., Los Angeles, leg. M. Spies, at GLACVCD unless otherwise specified: 3 Lex+Pex+ph♀ (on 1 slide), 1 Lex+P+ph♂, 1 Pex+♂ (at ZSM), Ballona Creek betw. Marina Fwy. & Lincoln Blvd., 28.VI.1993; 1♂, Ballona Creek near Rosy Circle homes, 28.VI.1993. – **B.** Los Angeles Co., leg. M. S. Mulla, J. Chaney & M. Breidenbaugh, at UCR: 1♂, 1♀, Marina del Rey, Centinela Creek W of Centinela Av., 21.V.1997; 2 L, Marina del Rey, Ballona Creek at confluence of Centinela Creek, 27.V.1997; 1♂, Marina del Rey, Ballona Creek W of Centinela Av., 4.VI.1997; 1♀, as previous, but 17.VI.1997; 1♂, Marina del Rey, near Sanford St. homes, 17.VI.1997; 2♂♂, 1♀, West Los Angeles, Ballona Creek near Hwy. 90, 5.VIII.1997. – **C.** Orange Co., Huntington Beach; unless otherwise specified: leg. M. Spies, at OCVCD: 2 L, 1 Pex, 1 Pex+ph♂ (all on 1 slide), 1 Lex+Pex+♂, Fountain Valley Channel at Bushard St., 9.VI.1993; 3♂♂, 1♀, Talbert Channel at Yorktown Av., 18.IX.1992; 1 Pex+ph♂, 1 Pex+♂, as previous, but 9.VI.1993; 1 Pex+ph♂, 1 Pex+♂, Talbert Channel at Girls & Boys Club, 9.VI.1993; 1 Lex+Pex+♀, 1 Pex+♂, 3 Lex+Pex+♂ (1 in coll. JES, 1 at ZSM), all data as holotype; 1 Lex+Pex+♂, as previous, but 9.VI.1993; 1♂, from light trap at Springdale St. & Littlefield Dr., 7.-13.IV.1993, leg. OCVCD.

Further records (USA, California): San Mateo Co.: Hillsborough, 27.X.1959 (JES, pers. comm.); San Mateo, Seal Slough (Whitsel et al. 1963); East Palo Alto, sump, 19.XI.1959, leg. R. Whitsel (JES); as previous, but golf course, 13.X. and 19.XI.1959 (JES); as previous, but pond next to golf course, 1960-1961 (Whitsel et al. 1963). Solano Co.: Lake Dalwigk near Vallejo, 2.XI.1960 (Whitsel et al. 1963); as previous, but 19.IV.1962, leg. G. Grodhaus (JES). Los Angeles Co.: Venice, residence at 37th St. and Carol Ct., 12.VII.1961, leg. D. H. Roke (JES).

Distribution and ecology. *Tanytarsus challeti*, spec. nov. has been found in near-coastal central and southern California, exclusively in habitats characterized by at least periodically elevated salinity levels (Whitsel et al. 1963: specific gravity 1.001-1.016, water temperature 6-26 °C; author's records: salinity 0.8-3.0 ‰, specific conductance 1730-5000 µS/cm, water temperature up to 34 °C). Since in non-turbulent situations saline water can form separate layers underneath freshwater, the open-water

measurements given may underestimate the species' actual salinity tolerance.

Whitsel et al. (1963: 91) found *T. challeti*, spec. nov. to be widespread in suitable lentic environments, and report high densities ("over 1000 fourth instar larvae per square foot") from soft sediment surfaces or around bases of aquatic macrophytes. The larvae are said to feed on algae, and to tolerate low dissolved oxygen concentrations. In the Los Angeles area the species was encountered in flood control channels, but only in very low flow conditions. Substrates consisted of mud, detritus and algae, occasionally among reed beds.

Adult emergence evidently takes place continuously throughout the warmer seasons (at least from April through early November), and unsynchronized multivoltine patterns may be inferred.

Due to its propensity to develop highly dense populations, but only in habitats of limited local distribution, *T. challeti*, spec. nov. has been assigned intermediate nuisance status in southern California.

Tanytarsus pelsuei, spec. nov.

"*Tanytarsus (Tanytarsus)* n. sp. 3" Darby, 1962; adult male in key, records.
"*Calopsectra* n.sp. 2" Frommer & Sublette, 1971; record.
"*Tanytarsus* sp. fitting the description of Darby's *Tanytarsus* n. sp. 3 (Darby 1962)" Norland & Mulla, 1975; chemical control.
"*Tanytarsus* n. sp. 3 after Sublette (Darby 1962)" Ali & Mulla, 1976; chemical control. Under same name: Ali et al. (1978), chemical control; Ali & Mulla (1979a), distribution and control; Ali & Mulla (1979b), emergence pattern.
"*Tanytarsus (Calopsectra)* new species 8" (partim); Sublette, 1979; ecology, distribution, larval karyotype.

Etymology. Named after Frank W. Pelsue, former manager of the Greater Los Angeles County Vector Control District (then Southeast Mosquito Abatement District), for his commitment to support basic taxonomic work, even in times of economic adversity. In pronouncing the species epithet, the "e" should be silent in order to keep the name dedication recognizable.

Description

Larva (see tab. 1).

Coloration. Head yellowish to light brown anteriorly, posterior ⅓ to ½ dark brown ventrally and laterally, frontoclypeus often darkened. Thorax reticulate green, yellow and red (all pale); abdomen pale red to orange, segments II-VII with greenish lateral ridges. In prepupae: red tinges fading, green and yellowish areas increasing.

Head. Labral seta SI with 0-3 median branches (Fig. 4C), SII simple and bladelike, SIII, SIV simple, fine; all long chaetae simple. Premandible with 4 darkened teeth (the most proximal small), and with the usual lateral spine. Mandible with 1 dorsal (pale), 1 apical and 3 inner teeth (dark). Antenna (Fig. 4B) with position of seta variable between about 0.5 and 0.75 of segment I length; blade length subequal to sclerotized section of segment II. Mentum with lateral parts of trifid median as dark as 5 pairs of lateral teeth, the middle part lighter.

Abdomen. Segments II-VII with lateral longitudinal ridges, the ends of the latter on VII at most slightly bulging to posterior. Procercus low, distally sclerotized, with 6-8 anal setae and 2 short lateral setae. Anal tubules normally developed, longer than supraanal setae.

Tubes of detritus.

Pupa (see tab. 2).

Coloration. Greenish, cephalothorax darker. Exuviae with cephalothorax mostly brown incl. wing sheath vein traces; abdominal tergite II with longitudinal grayish-brown pigment patches (faint on some specimens), TVIII laterally, almost all of TIX brownish.

Head. Cephalic tubercle (CT) prominent, its narrowed apex elongate (Fig. 5C), at least ½ length of frontal seta. Antennal pedicel sheath with tubercle at most ½ as long as apex of CT.

Thorax. Median suture flanked by at most very few granules. Thoracic horn with sparse chaetae lining approximately 2nd ¼ of horn length (similar to fig. 5B); chaetae about 3 horn diameters long, difficult to see if slide-mounted adpressed to horn. Prealar mound at most a very low ridge.

Abdomen. Tergite armament: TII with extensive shagreen in "Π" pattern, transverse section extending

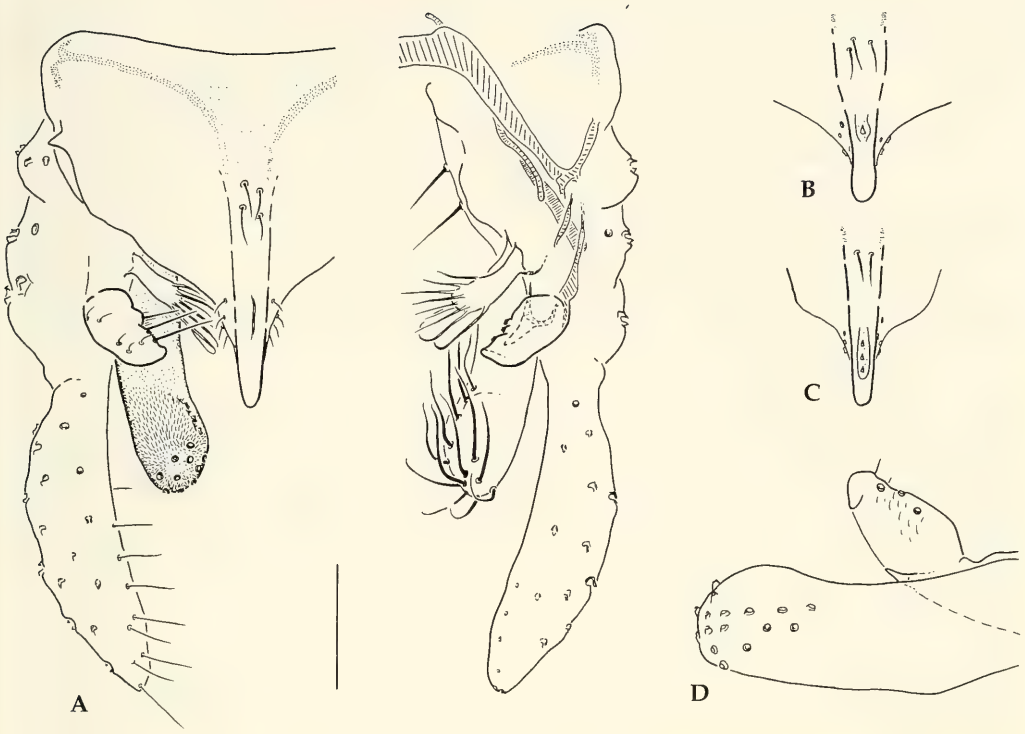

Fig. 2. *Tanytarsus pelsuei*, spec. nov. Adult male. **A.** Hypopygium, dorsal (scale 50 µm). **B, C.** Anal point variations, dorsal. **D.** Superior and inferior volsellae, median aspect.

to anterior tergite corners, and including a pair of submedian areas with slightly enlarged points; hook row spanning about ⅓ of segment width (½ of T); TIII-VI (Fig. 5D) with pairs of longitudinal bands of points set on gray pigment, TIII bands connected to antero-lateral shagreen patches, longer bands reaching to about mid-tergite, often shorter on VI; TVIII with small round, TIX with transverse anterolateral shagreen patches. Sternite armament: SI, II with extensive fine shagreen, SVIII with antero-lateral shagreen. Dorsal setae I-II: 3; III-VII: 5; VIII: 2 (the postero-lateral strong); O-setae: 1 pair each on II-VII; sensillae campaniformes: 1 central and 1 posterior pair on II, III. Lateral setae I: 0; II-V: 3; VI: 2 regular setae + 1 posterior taenia (rarely reduced to long, non-taeniate); VII: 2 regular + 2 taeniae; VIII: 5 taeniae with $L_{2,3}$ displaced toward median. Ventral setae I: 0; II: 3; III-VII: 4; VIII: 1 central pair, semi-taeniate. PsA absent. PsB weak, rarely prominent. Anal comb with 5-6 marginal teeth, ventral surface ("disc") relatively small, number and size of disc spines highly variable.

Adult male (see tab. 3).

Coloration. Mostly greenish, thoracic vittae, median anepisternum II, preepisternum (except dorsal margins), and postnotum (except anterior margin) brown. Wing squama with a dark spot.

Head. Eye extension reaching little more to median than ventral end of eye, with median marginal contour indistinct, grading into microtrichiose frons. Frontal tubercles digitiform.

Thorax. Scutellum usually with three discrete groups of setae, the median group set slightly more posterior.

Wing. Membrane setae reaching level of RM in cells r_{4+5} and m_{1+2}, setae also present in m_{3+4}. Anal lobe not prominent.

Legs. Segment lengths as percentage proportions of the respective tibia (n=4):

	fe	ti	ta_1	ta_2	ta_3	ta_4	ta_5
P_1	168-179	100	202-233	93-105	84-94	66-76	30-34
P_2	121-124	100	59- 63	32- 33	25-27	17-19	12-14
P_3	98-101	100	65- 67	38- 40	35-37	22-24	12-13

Tibial spur length increasing from P_1 to P_3, on P_2 and P_3 one spur slightly longer than the other; mid and hind tibial combs separate, fully developed.

Hypopygium (Fig. 2). Anal tergite bands separate, their ends almost touched by the far anterior anal point origins. T IX with 2-4 (7 of 12 specimens: 2) dorsomedian and 11-14 distal setae; lateral tooth simple, or absent. Anal point fairly wide, with rounded apex; sensillar pit absent (10 of 15 specimens) or present; if absent, rudimentary contour often visible in dorsal view (Fig. 2A); if present, pit floor of limited extent (Figs 2B, C), with 1-3 sensillae basiconicae surrounded by sparse microtrichia in more extensive pits; no anal point crests evident. Superior volsella (Figs 2A, D) with distal half of setiger in lateral view strongly, in dorsal aspect at most moderately narrowing, apex with a ventromedian lip or hook; setiger bearing median microtrichia varying in length, 2-4 median setae (usually 3: the distal 2 stronger), and 5-8 small dorsal to lateral setae; digitus short, 30-43 % of setiger length. Inferior volsella densely microtrichiose and with median to caudal setae, distally with expansion to dorsal. Median volsella with stem shorter than setiger of superior volsella, distally setose, with 2-3 lamellate setae of spatulate type (Sæther 1980: fig. 23). Gonostylus with moderate widening in midsection, apex rather blunt.

Adult female.

Similar to male except as listed in tab. 4. Genitalia: practically indistinguishable from other *Tanytarsus* females studied. The winding spermathecal duct listed in tab. 4 may be a preparation artefact.

Systematics. See corresponding section under *T. challeti*, spec. nov.

Differential diagnoses

The larva of *Tanytarsus pelsuei*, spec. nov. can be identified by the combination of characters given in tab. 1, especially the unusual labral seta SI. *T. fuscithorax* Skuse and *semibarbitarsus* Glover could not be directly compared in the present study, but differ at least by significantly shorter Lauterborn organ stalks (Cranston 1996, Kokkinn 1986).

Among other pupae with the "*mendax* group" character pattern (see diff. diagnoses for *T. challeti*, spec. nov.) *T. pelsuei*, spec. nov. is most similar to *T. mendax* Kieffer and *T. challeti*, spec. now. The longer apex of the cephalic tubercle, presence of a wing sheath nose, of antero-lateral shagreen on abdominal tergite III, and 2 dorsal setae in the postero-lateral corner of TVIII distinguish *T. pelsuei*, spec. nov. from *T. challeti*, spec. nov.. Pupae of *T. mendax* and *T. pelsuei*, spec. nov. are at present only tentatively separable by relative thoracic horn length: California *mendax* Pex = 4-6.5 mm, thor. horn = 600-850 µm; *pelsuei* Pex = 3.5-4.5 mm, thor. horn = 330-375 µm. Pupae of Australian *fuscithorax* group members (*fuscithorax* Skuse, *semibarbitarsus* Glover) most strikingly differ by much longer cephalic tubercles, and by the abdominal point patches continuing posteriorly as longitudinal shagreen on at least some tergites (Cranston 1996).

Adult males of *T. pelsuei* can be distinguished from nearly all congeneric species on hypopygial features alone. The combination of the sensillae basiconicae being concentrated in a discrete pit of limited extent on the anal point surface (with reduction tendencies leading to complete absence of pit and/or sensillae), a superior volsella with an apical, ventro-median lip or hook on the setiger, and a short digitus, is only matched by *T. challeti*, spec. nov., the Australian *T. barbitarsis* Freeman and *semibarbitarsus* Glover (Glover 1973), and the Afrotropical to Mediterrranean *T. horni* Goetghebuer. *T. pelsuei*, spec. nov. differs from *challeti*, spec. nov. (compare tab. 3) by consistently higher antennal and fore leg ratios at comparable body sizes, palpomere 5 showing no signs of reduction, a much more extensively setose wing, and the anal point origins reaching far anterior. From *barbitarsis* Freeman, *T. pelsuei*, spec. nov. may be distinguished by the tibial combs showing no signs of reduction, the much more extensive wing setation, by the (usual) presence of dorsomedian TIX setae, and a narrower anal

point. *T. semibarbitarsus* differs by lacking dorsomedian TIX setae, and by carrying conspicuously longer distal setae on the median volsella. *T. horni* has a wider anal point, lateral rather than median microtrichia on the setiger, and apically acute median volsellar setae of foliate, not spatulate type (compare Sæther 1980: figs 22, 23).

Unassociated female adults of *T. pelsuei*, spec. nov. could not be identified against other species (in the study area: *angulatus* Kawai, *dendyi* Sublette) with any of the characters examined.

Types. Holotype: adult ♂ (on slide, in Euparal), USA, California, Orange County, Anaheim, Kraemer Flood Control Basin, 29.IV.1993, leg. M. Spies, deposited at Snow Entomological Museum, University of Kansas, Lawrence, Kansas, USA.

Paratypes (all USA): **A.** California, Los Angeles Co., Los Angeles, leg. M. Spies, at GLACVCD unless otherwise specified: 1 Pex+ph♂ (on 1 slide with 2 Pex+ph♂ of *Tanytarsus mendax* Kieffer), Pico Rivera, San Gabriel Coastal Spreading Basin #3, 13.IV.1993; 1 Pex+♀, 3♂♂, Pico Rivera, San Gabriel River at Washington Blvd., 13.IV.1993. – **B.** California, Orange Co.; unless otherwise specified: leg. M. Spies, at OCVCD: 3 L (on 1 slide, together with 1 L of *Tanytarsus* sp. indet.), La Mirada, Coyote Creek at Hillsborough Dr., 15.VI.1993; 1 Pex+♀, 1 Lex+Pex+ph♀, Anaheim, Anaheim Lake, 19.III.1993; 2♂♂, Anaheim, Miller Flood Control Basin, 29.IV.1993; 1♂, all data as holotype; 1 Lex+Pex+♀, 1 Pex+ph♂, 1 L (on 1 slide with 3 L of other spp.), Anaheim, Santa Ana River at Glassell St., 16.IX.1992; 1♂, Anaheim, Santa Ana River at Lincoln Av., 17.V.1993; 1♂, Anaheim, Santa Ana River Flood Control Basin N of Ball Rd., 9.XI.1992; 2♂♂ (at ZSM), Anaheim, Bedford Circle homes, 29.IV.1993. – **C.** Miscellaneous, in coll. F. Reiss: 1♂, California, Riverside Co., Rancho Mirage, Wilshire Palms Country Club, IV.1980, leg. F. Bachmaier; 1♂, New Mexico, Grant Co., Gila River at Hwy. 180 W of Silver City, 7.VIII.1980, leg. F. Reiss.

Further records (all USA). **A.** California: Butte Co.: Thermalito Forebay 2 mi. W of Oroville, 18.VI.1969, leg. G. Grodhaus (JES, pers. comm.). Yolo Co., rice fields near Davis, 2-13.VII.1956 and 29.VIII.1958 (Darby 1962); Davis, 1.VI.1974, leg. S. L. Clement (JES). Sacramento Co.: rice fields near Rio Linda, 17.VIII.1957, 11.IX.1957, 24.VI.1958, 4.VII.1958, 10.VII.1958 (Darby 1962). Fresno Co.: 6 mi. W of Firebaugh, 8.V.1962, leg. D. E. Reed (JES). Inyo Co.: Death Valley Natl. Monumt., Furnace Creek, 31.III.1951, leg. R. L. Usinger (JES). Los Angeles Co.: Pico Rivera, San Gabriel River at Washington Blvd., 24.VI.1993, leg. M. Spies; Pico Rivera, Rio Hondo and spreading basins, VII-X.1960, leg. E. C. Bay (JES); as previous, but 24.VI.1993, leg. M. Spies; Whittier, Rio Hondo, I-II.1960, leg. L. D. Anderson (JES); as previous, but X.1960, leg. S. I. Frommer (JES). Orange Co.: Buena Park, Coyote Creek at Tulare St., 5.X.1992, leg. M. Spies; Anaheim, Atwood Channel between Rose Dr. & Miller St., 19.III.1993, leg. M. Spies; Anaheim, Santa Ana River channel and basins, IV.-X.1975 (Ali & Mulla 1976); Anaheim, Santa Ana River E of 91 Fwy., 17.V.1993, leg. M. Spies; Anaheim, Santa Ana River Flood Control Basin S of Lincoln Av., 5.XI.1992, leg. M. Spies; Placentia, intersection of Chapman & Orangethorpe Aves., 16.III.1993, leg. D. D. Loughner; as previous, but San Miguel Circle homes, 17.III.1993; Laguna Cyn., 7.I.1964, leg. M. E. Drurie (JES). Riverside Co.: Corona, Village Grove Lake, IV.1977-IV.1978 (Ali et al. 1978); Mira Loma, Swan Lake, 11.II.1963, leg. L. D. Anderson (JES); Lake Elsinore, VII-VIII.1969 (JES); Riverside, 14.IX.1962, leg. S. I. Frommer (JES); Palm Desert, 22.V.1970 (JES); Deep Canyon near Palm Desert, VI.1964 (Frommer & Sublette 1971); as previous, but V-VI.1970 (JES); Indio, 15. and 22.V.1970 (JES); Coachella, 15.V.1970 (JES); Thermal, 22.V.1970 (JES); Mecca, 8. and 22.V.1970 (JES); experimental ponds near NW corner of Salton Sea, XII.1972-IV.1973 (Norland & Mulla 1975). – **B.** Colorado: Archuleta Co.: Navajo River nr. New Mexico state line, 7.X.1974 (JES). – **C.** New Mexico (all JES): Colfax Co.: Canadian River at Taylor Springs, 6.IX.1974. Santa Fe Co.: Rio Grande W of San Ildefonso, 5.X.1974. Guadalupe Co.: Pecos River at Puerto de Luna, 28-29.IX.1974. Quay Co.: Canadian River E of Logan at mouth of Revetto Creek, 1.X.1974. Curry Co.: Frio Draw 16 mi. N of Clovis, VIII,IX.1967. Socorro Co.: Rio Grande at San Marcial, 11.VII.1976. Hidalgo Co.: Gila River at Arizona state line, 21.IX.1974. Doña Ana Co.: Rio Grande near El Paso, Texas, XI,XII.1974, 14.II. and 8.VII.1976. Eddy Co.: Pecos River E of Artesia, X-XII.1974; Pecos River nr. Texas state line, X,XI.1974 and 7.III.1976. – **D.** Texas (all JES): Lubbock Co.: Lubbock, 6.VIII.1956. Victoria Co.: Victoria, nr. Guadalupe River, 14.VI.1960. Liberty Co.: 7 mi. W of Liberty, 16.VI.1960. Orange Co.: Beaumont, nr. Neches River, 12-13.VI.1960. – **E.** Louisiana (all JES): Sabine Co., Many, bank of polluted stream, 6.IV.1960. Natchitoches Co.: Red River N of Grand Encore, 5.X.1959.

Distribution and ecology. *T. pelsuei*, spec. nov. is widely spread in the southwestern to mid-southern United States, and likely in northern Mexico as well. So far, the species has not been documented farther north than central California, but this range may be well extended in the Midwest region (JES, pers. comm.). Sources include shallow standing waters as well as slow- to moderate-flow zones of rivers, creeks and flood control channels.

In the Los Angeles area, larvae were found on sandy and silty substrates with detritus and frequently also clusters of filamentous algae. Water temperatures measured during sampling ranged

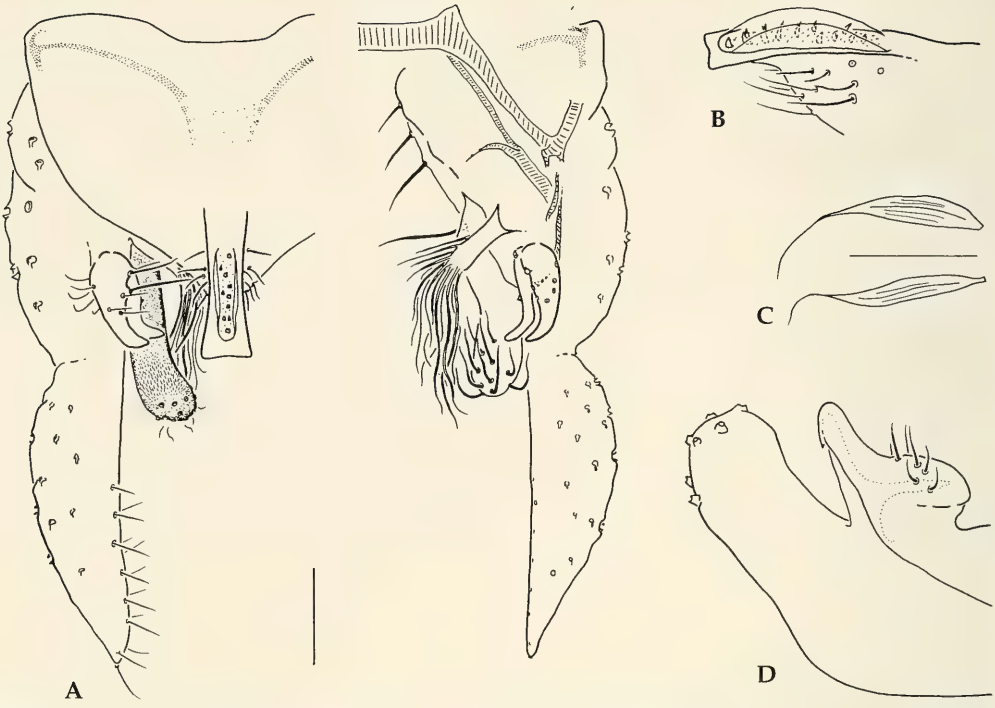

Fig. 3. *Tanytarsus angulatus* Kawai. Adult male. **A.** Hypopygium, dorsal (scale 50 µm). **B.** Anal point, lateral. **C.** Subulate setae of median volsella (scale 50 µm). **D.** Superior and inferior volsellae, lateral aspect.

up to 29 °C, and specific conductances from 385 to 1410 µS/cm, with salinities never above 0.7 ‰. Darby (1962) collected adults around rice fields in central California. The few specimens taken in emergence traps all came from moving water and aquatic plant stands including *Spirogyra* growths. Aerial catches were made from mixed swarms in which *T. pelsuei*, spec. nov. was taken along with two or three of the species *Parachironomus tenuicaudatus*, *Cricotopus bicinctus*, *C. sylvestris*, and *Apedilum* spec.

In warmer regions of its distribution area, *T. pelsuei*, spec. nov. adult emergence apparently can occur throughout the year, and unsynchronized multivoltine patterns may be inferred.

T. pelsuei, spec. nov. was present at roughly half of the sites visited, and in almost 50 % of the samples collected during the author's southern California study. Due to its propensity to develop abundantly in a variety of habitats, the species is considered one of the primary local nuisance chironomids.

Tanytarsus angulatus Kawai, 1991

"Calopsectra n.sp. 1" Frommer & Sublette, 1971; record.
Tanytarsus angulatus Kawai, 1991: 168; adult male. Sasa & Kikuchi (1995); adult male.

Description

Larva (see tab. 1).

Coloration. Head light brown, postmentum with extensive postero-median dark area. Thorax green or yellowish green, abdomen pale red to orange. In prepupae: red tinges fading, green and yellowish areas increasing.

Head. Labrum with SI combed, SII simple and bladelike, SIII, SIV simple, fine; all long chaetae simple. Premandible with 4 not significantly darkened teeth (the most proximal small), and with the usual lateral spine. Mandible with 1 dorsal (pale), 1 apical and 3 inner teeth (dark). Antenna (Fig. 4D)

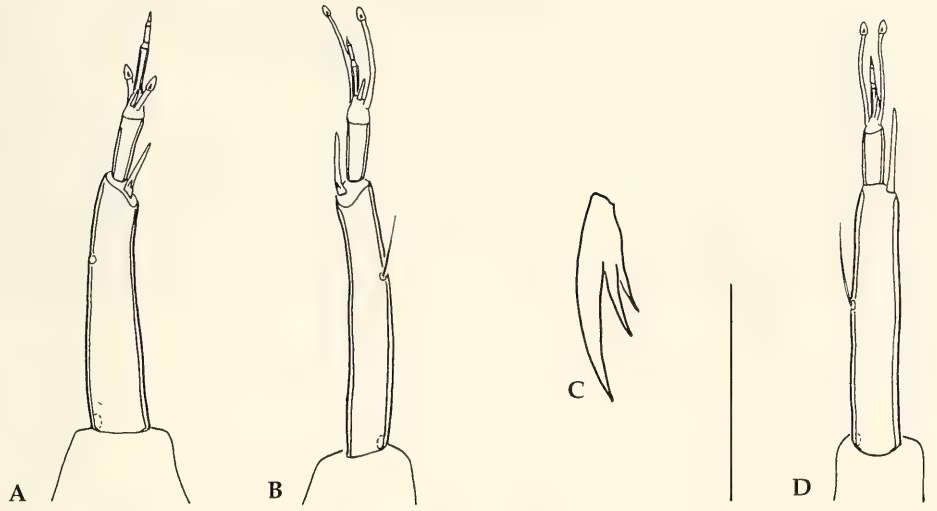

Fig. 4. Larval structures of three species of *Tanytarsus* – **A, B, D**: antennae (scale 100 µm); **C**: labral seta SI (not to scale). **A.** *T. challeti*, spec. nov. **B, C.** *T. pelsuei*, spec. nov. **D.** *T. angulatus* Kawai.

with seta just beyond middle of segment I; blade longer than segment II. Mentum with lateral parts of trifid median as dark as 5 pairs of lateral teeth, the middle part lighter.

Abdomen. Procercus low, distally sclerotized, with 7-8 anal setae and 2 short lateral setae. Anal tubules normally developed, longer than supraanal setae.

Pupa (see tab. 2).

Coloration. Cephalothorax mottled brown, abdomen light green. Exuviae with cephalothorax mostly brown incl. antennal sheaths and wing sheath vein traces; abdominal tergite II with pair of posterior, triangular pigment patches, TVIII laterally, almost all of TIX brown.

Head. Cephalic tubercle (CT) prominent, its narrowed apex elongate, about ⅙ to ⅓ length of frontal seta. Antennal pedicel sheath with tubercle at most ½ as long as apex of CT.

Thorax. Median suture area nearly smooth, at most with short, narrow strips of granules. Precorneal setae in a row slanting from anterodorsal to posteroventral. Prealar mound an elongate, posteriorly swollen ridge.

Abdomen. Tergite armament (Fig. 5E): TII with extensive shagreen in "Π" pattern, the longitudinal strips narrowly separated, posteriorly often meeting, postero-laterally flaring to ends of hook row, the latter spanning about ½ of segment width (⅔ of T); TIII with pair of single, staggered rows of long needle spines laterally accompanied by scattered shorter spines and points and a narrow band of brown pigment, rows moderately diverging to posterior and reaching from anterior of seta D_1 to posterior of D_5, scattered shagreen or patches sometimes present antero-lateral of needle rows; TIV with pair of nearly parallel needle patches (Fig. 5F) laterally accompanied by 2-3 rows of points anteriorly and by brown pigment band throughout, anterior needles often distinctly shorter, rows reaching from about level of O-setae to near D_5; TV with pair of longitudinal point patches roughly between levels of setae O and D_1, integument in patches mostly brown, patches about 5 rows wide, the antero-median points often slightly elongate; TVI with patches similar to V but only half as long; TVIII with small anterolateral shagreen patches; TIX with pair of anterior transverse shagreen patches including short row groups. Sternite armament: SII with anterior transverse fine shagreen, SVIII with antero-lateral shagreen. Dorsal setae I-II: 3; III-VII: 5; VIII: 1 (long, postero-lateral); O-setae: 1 pair each on II-VII; sensillae campaniformes: 1 central and 1 posterior pair on II-VI. Lateral setae I: 0; II-IV: 3; V-VI: 2 regular setae + 1 posterior taenia (occasionally semi-taeniate or regular); VII: 2(3) regular + (1)2 taeniae; VIII: 5 taeniae, $L_{(2-)3}$ usually displaced toward median, L_5 rarely reduced to regular. Ventral setae I: 0; II: 3; III-VII: 4; VIII: 1 central pair of taeniae. PsA absent. PsB weak, rarely prominent. Anal

comb with 7-13 marginal teeth, ventral surface ("disc") usually mostly covered with teeth, including some not much smaller than those on margin.

Adult male (see tab. 3, and Kawai 1991).

Coloration. Thorax base color yellowish to green, abdomen bright green; antennal pedicel, flagellum and plume, thoracic vittae, median anepisternum II, preepisternum (except dorsal margins), and postnotum (except anterior margin) brown; foreleg brownish from about mid femur, darker than mid and hind legs; wing brachiolum (proximally) and squama (distally) each with a brown spot.

Head. Eye extension reaching little more to median than ventral eye parts, with median marginal contour indistinct, grading into microtrichiose frons. Frontal tubercles digitiform to weakly conical.

Thorax. Scutellum usually with three discrete groups of setae, the median group set slightly more posterior.

Wing (see Kawai 1991: fig. 6a). Note the presence of membrane setae well proximal of RM in cell m_{1+2}, and the setae in cell an (marginally). Anal lobe not prominent.

Legs. Segment lengths as percentage proportions of the respective tibia

A: California (smallest/largest complete specimen):

	fe	ti	ta_1	ta_2	ta_3	ta_4	ta_5
P_1	183/169	100	229/204	105/91	90/76	67/60	29/28
P_2	122/121	100	62/59	36/33	25/24	16/13	11/11
P_3	107/106	100	65/62	40/39	36/34	22/21	10/11

B: Japan (holotype/paratype no. 24):

	fe	ti	ta_1	ta_2	ta_3	ta_4	ta_5
P_1	198/195	100	262/255	124/116	102/95	81/70	31/32
P_2	126/-	100	63/-	34/-	25/-	14/-	11/-
P_3	109/-	100	72/-	44/-	36/-	22/-	11/-

Tibial spur length increasing from P_1 to P_3, on P_2 and P_3 one spur each with outcurved apex, on P_2 the straight spur considerably shorter; mid and hind tibial combs separate, fully developed.

Hypopygium (Fig. 3, and Kawai 1991: fig. 6b). Anal tergite bands separate, usually ending far proximal of anal point origins. T IX with 10-20 distal setae, dorsomedian setae and lateral teeth absent. Anal point fairly wide, narrowest in middle, apex subrectangular, occasionally with shallow posteromedian emargination; sensillar pit extensive, flanked by anal point crests; pit floor with 5-12 (13) uni- to multi-peaked sensillae basiconicae in single to irregularly double row, and with sparse microtrichia, except distally. Superior volsella (Figs 3A, D) in dorsal view slender, with long, bare distal hook to median; setiger with 11-13 setae from medio-proximal to about mid volsella, across dorsal surface there, and laterally to proximal; the most anterior median seta occasionally in very basal position proximal of digitus origin, 2-3 further distal median setae stronger and longer than others; digitus long, distally curving to median, paralleling and almost as wide as distal hook of volsella; origin of digitus connected to superior and inferior volsella (Fig. 3D). Inferior volsella with little distal expansion to dorsal (Fig. 3D), densely microtrichiose and with distal median to caudal and dorsal setae. Median volsella with stem shorter than superior volsella, carrying many setae some of which reach beyond tip of inferior volsella; with about 10 lamellate setae of subulate type (Sæther 1980: fig. 20), their distal thirds to halves abruptly attenuated to single filaments (Fig. 3C). Gonostylus distally strongly narrowing to more or less pointed apex.

Adult female.

Similar to male except as listed in tab. 4. Genitalia: indistinguishable from other *Tanytarsus* females studied.

Identification. The only notable difference detected between Japanese and Californian males of *T. angulatus* lies in proportionately slightly shorter fore tibiae on the type specimens, yielding a higher LR_1 at comparable body sizes (see leg segment tabulations above, and tab. 3). This discrepancy is

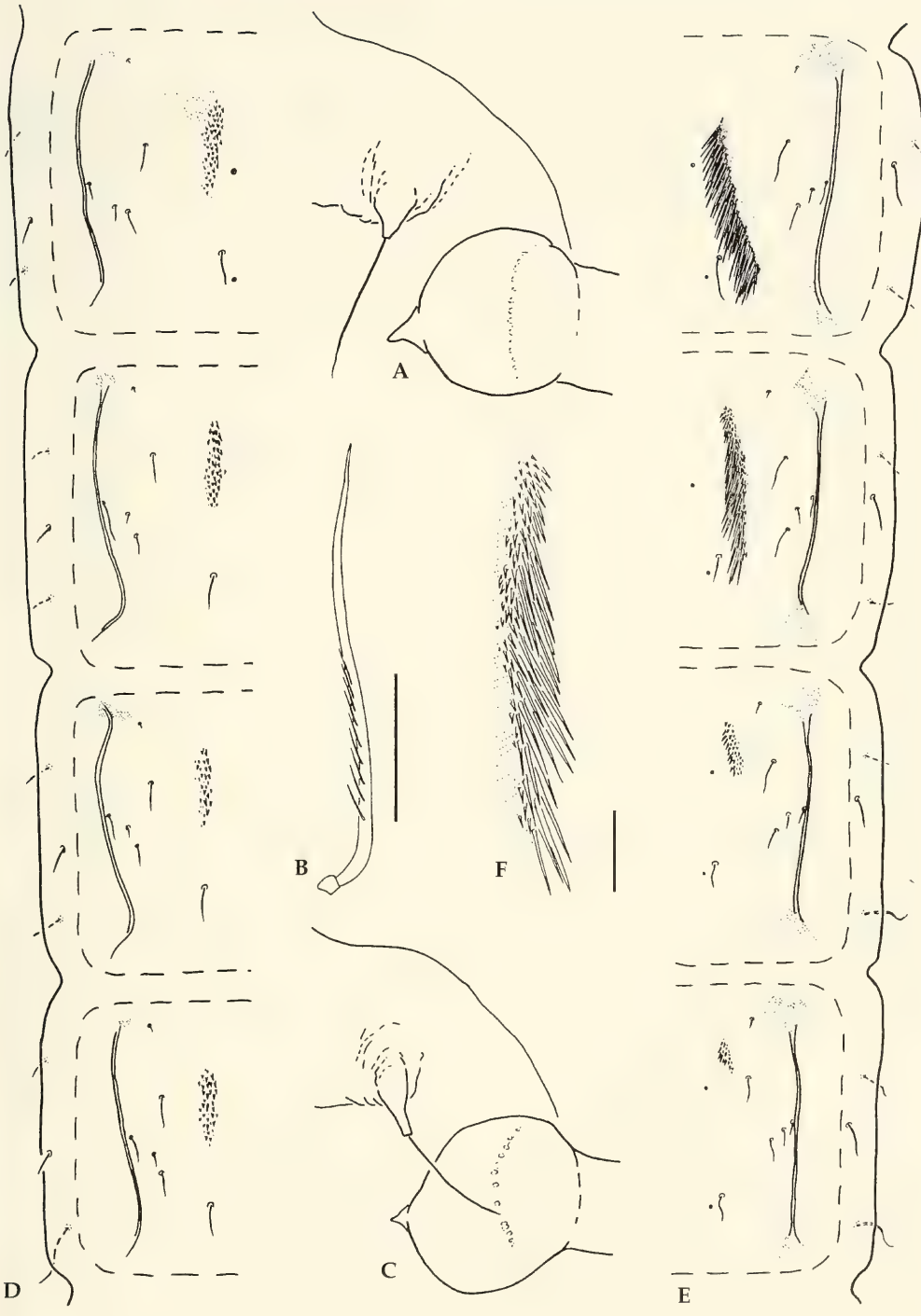

Fig. 5. Pupal structures of three species of *Tanytarsus* – **A, C**: frontal region; **B**: thoracic horn (scale 200 µm); **D, E**: abdominal terga III-VI; **F**: spine patch of TIV (scale 50 µm). **A, B.** *T. challeti*, spec. nov. **C, D.** *T. pelsuei*, spec. nov. **E, F.** *T. angulatus* Kawai.

interpreted as inter-populational variation, and cautions against overstressing such isometrics in diagnoses if data are based on material from single or few populations.

Differential diagnoses

The adult male of *Tanytarsus angulatus* Kawai differs from all described congeners by its unique combination of hypopygial characters. An anal point distally widened as in *angulatus* is known only from *T. occultus* Brundin, but that species has significantly larger sensillae basiconicae, fully developed dorsomedian T IX setae, and short median volsella setae without distal filaments (Reiss & Fittkau 1971). The pupae of the two species are also very different, the abdominal armament, for example, lacking long needle spine patches in *occultus* (Langton 1991).

The median volsella of *angulatus* resembles those of *T. lugens* Kieffer and *bathophilus* Kieffer (compare fig. 3C to Reiss & Fittkau 1971: fig. 40). Like *angulatus*, *T. lugens* and *bathophilus* also lack dorsomedian T IX setae, and show the tendency of the most anterior median seta on the superior volsella to move into a very proximal and ventral position. On the other hand, the digitus is very reduced in *bathophilus*, and even lacking in *lugens*.

A most closely related species, however, appears to be *T. takahashii* Kawai & Sasa, 1985, possessing a very similar median volsella, digitus and setation pattern on the setiger of the superior volsella. The latter is also slender, but the distal section is not as long and strongly hooked as in *angulatus*. The inferior volsella and gonostylus are again similar. The anal point of *takahashii* differs by ending in a gently narrowing, rounded rather than rectangular tip. The ninth tergite bears a few dorsomedian setae (absent in *angulatus*), but these appear relatively strongly reduced.

Among known Holarctic *Tanytarsus* pupae, *T. angulatus* Kawai is very similar to *bathophilus* Kieffer in many features (e.g., details of the abdominal armament pattern), but *bathophilus* specimens of comparable size always have much longer thoracic horns (Langton 1991: range 465-740 µm), the precorneal setae arranged in a triangle, and the hook row covering only about ⅓ of the width of abdominal segment II (Langton 1991, and author's observations on ZSM material). The pupa of *T. takahashii* Kawai & Sasa is unknown.

Although an overview allowing comparisons with all described *Tanytarsus* larvae is unavailable, those of *T. angulatus* Kawai should be identifiable by the characters given in Table 1, especially by the head capsule pigment pattern combined with only lightly sclerotized premandibles. The larvae of *T. takahashii* Kawai & Sasa and *bathophilus* Kieffer are undescribed.

Unassociated female adults of *T. angulatus* could not be identified against other species in the California samples with any of the characters examined. While the number of sensillae chaeticae on mid tarsus 1 of *angulatus* is always low compared to specimens of *challeti* and *pelsuei*, nov. specs. (see tab. 4), it is similarly low in *T. dendyi* Sublette, another species occurring in the study area.

Material analyzed. Japan, Toyama Prefecture (from priv. coll. K. Kawai): holotype ♂, Dokawa River near Matsuo Jinja, 24.V.1983; 1♂ (paratype No. 24), same as holotype; 1♂ (paratype No. 22), Oyabe River at Hijiri-bashi, 29.V.1984; 1♂, (paratype No. 27), agricultural canal near Toyama prison, IV-V.1983. – **USA**, California, leg. M. Spies unless otherwise specified (at GLACVCD, OCVCD, ZSM): **A.** Los Angeles County: 1♂, Long Beach, Los Angeles River at Pacific Coast Hwy., 24.III.1993; 1 L, 1 Pex, Pico Rivera, Rio Hondo Coastal Spreading Basin #1, 13.IV.1993; 1♂, 1 Pex+♀, Pico Rivera, San Gabriel River at Washington Blv., 13.IV.1993; 1 Lex+Pex+♀, as previous, but San Gabriel River Spreading Basin #3; 1 Lex+Pex+ph♀, La Mirada, Coyote Creek at Hillsborough Dr., 3.V.1993; 1♂, as previous, but at Dundee Court. – **B.** Orange County: 3 Lex+P+ph♂, 1 P+ph♂, 1 Lex+Pex+ph♀, 4 Lex+Pex, 2 Pex, 1 L, Anaheim, Atwood Channel betw. Rose Dr. & Miller St., 19.III.1993; 1 Lex+Pex+♂, Anaheim, Anaheim Lake, 19.III.1993; 1 Pex+♂, Anaheim, Santa Ana River channel E of Lakeview Av., 17.V.1993; 2 Pex, as previous, but retarding basin N of Ball Rd., 9.XI.1992; 1♂, Fullerton, from trap at Fullerton College, 19.V.1993, leg. OCVCD; 2♂♂, Placentia, Chapman & Orangethorpe Aves., 16.III.1993, leg. D. D. Loughner; 1♂, as previous, but at Pasteur Pl., 10.III.1993; 1♂, Anaheim, from trap near Santa Ana River, 23.XI.1993, leg. OCVCD.

Further records (all USA, California). **A.** Leg. M. Spies: Los Angeles and Orange Cos., numerous specimens of all stages from the above and adjacent sites, X,XI.1992 and III,IV.1993. – **B.** Humboldt Co.: Fortuna, 24.V.1960, leg. L. W. Mackay (JES, pers. comm.). Shasta Co.: Redding, Kutras Lake, 1.VI.1965, leg. G. Grodhaus (JES). Tehama Co.: Red Bluff, 1.VI.1965, leg. G. Grodhaus (JES); Black Butte Reservoir, 13.V.1966, leg. Oldham et al. (JES). Butte Co.: Thermalito Afterbay W of Oroville, V,VI.1968, leg. G. Grodhaus (JES). Yolo Co.: Davis, 1.VI.1975, leg. S. L. Clement (JES). Contra Costa Co.: Antioch, 5-6.IV.1956, leg. M. Wasbauer (JES). Los Angeles Co.: San Gabriel, 8-16.I.1962, leg. S. I. Frommer (JES); Whittier, Rio Hondo, 20.XI.1959 and 17.II.1960, leg. L. D. Anderson (JES); as previous, but 3-7.V.1962 (JES). Riverside Co.: Corona, 29.IV.1967, leg. R. D. Sjogren (JES); Arlington,

V,VI.1967, leg. R. D. Sjogren (JES); Hidden Lake 3 mi. N of Arlington, V,VI.1967, leg. R. D. Sjogren (JES); Norco, V,VI.1967, leg. R. D. Sjogren (JES); 2 mi. W of Pedley, 28.IV. and 9.XI.1967, leg. R. D. Sjogren (JES); Deep Canyon near Palm Desert, 18.V.1964, leg. M. E. Irwin (Frommer & Sublette 1971, JES).

Ecology and phenology. The larvae from which the type series of *T. angulatus* was reared all came from sand or mud substrates in stagnant parts of Japanese rivers classified as β- to α-mesosaprobic (Kawai et al. 1989, Kawai 1991). In urban California, the species has been found in flowing waters ranging from rivers to concrete-lined open conduits, but also in the littoral of flood control basins, with substrates of mostly silt and sand enriched with detritus and algal growth. Instantaneous daytime water temperatures recorded by the author ranged from 17 to 29 °C, and conductivity from 380 to 1410 µS/cm, while salinity never exceeded 1 ‰.

The Japanese collections were made in April-June, October and November (Kawai 1991), but no samples were taken at *angulatus* sites in the months inbetween (Kawai et al. 1989). In the southern California study, pre- or post-emergence stages were also encountered at practically all sampling times (September-November, March-June). Non-synchronous, multivoltine life cycles can thus be inferred for populations in both cases.

T. angulatus was present at two out of three sites visited during the author's nuisance midge study, and in over 50 % of the samples. Adults of the species have also been encountered at sites visited in response to midge control requests. Consequently, *angulatus* is ranked among those Chironomidae with the highest nuisance potential in southern California.

Faunal relations. Prior to the present study, *Tanytarsus angulatus* Kawai was known only from a limited area in Japan: several connected and neighboring rivers draining into Toyama Bay, west-central Honshu (Kawai 1991, Sasa & Kikuchi 1995). In light of the California records, the distribution now appears as two widely disjunct patches of very restricted extent within their respective Far East Palaearctic and Western Nearctic regions. To this author's knowledge, such a pattern has not been reported in the Chironomidae, and seems at least exceptional in aquatic zoogeography in general (Banarescu 1992). However, most areas along a potential linking path across the Bering Strait have not received sufficient coverage in chironomid research to reasonably exclude the possibility of such dispersal.

As discussed above, *T. angulatus* stands isolated among its American congeners on present morphological evidence. Its apparent closest relative, *T. takahashii* Kawai & Sasa, is widespread in Japan (Sasa & Kikuchi 1995) and probably the eastern Palaearctic in general (new records from ZSM material: China, Beijing, 8.VI.1980, leg. E. J. Fittkau; North Korea, 3 records in Reiss (1980) sub "*Tanytarsus* sp. K1"). *T. bathophilus* Kieffer, with a highly similar pupa and partially similar male hypopygium, so far is known only from the western Palaearctic. The conclusion from these putative relations of *angulatus* would make it an immigrant to the Nearctic with (eastern) Palaearctic roots.

As for the above-discussed link between *Tanytarsus challeti*, spec. nov., *T. pelsuei*, spec. nov. and their Australian counterparts, the routes, directions and time frames of the inferred trans-Pacific dispersal can not be firmly established on the present evidence. However, while extensive distributions of three of the four members in the hypothesized Australian/Californian clade point to an earlier date for the underlying biogeographic event, circumstances in the case of *T. angulatus* Kawai leave recent human transport by ship or airplane as a plausible explanation.

Acknowledgements

The work presented constitutes part of a doctoral dissertation in preparation at the University of Munich, Germany, supervised by Prof. E. J. Fittkau. Prof. G. Haszprunar, director of the Zoologische Staatssammlung München, kindly granted the author full use of ZSM facilities for the duration of this program. The field and initial laboratory work was jointly funded by OCVCD and GLACVCD. I am deeply grateful to friends and colleagues in the southern California vector research community, too numerous to be mentioned individually, for all their support. F. Reiss (Munich), J. E. Sublette (Tucson), K. Kawai (Hiroshima), M. Breidenbaugh (UCR), and P. S. Cranston (Canberra) kindly provided specimens, expert opinions, etc.

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